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Aerobic Thermophile Biodegradation of BTEX

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In the aftermath of heat-driven subsurface remediation efforts such as steam stripping or Joule heating for cleaning up fuel spills, there will be a time during which the entire underground environment remains at temperatures significantly higher than ambient. The possible use of thermophilic bacteria capable of degrading select fuel hydrocarbons would take advantage of these higher underground temperatures to enhance the removal of low levels of residual regulated fuel contaminants. Twenty six thermophilic bacterial strains from the American Type Culture Collection were screened and two aerobes, *Thermus aquaticus* (ATCC 25104) and *Thermus* sp. (ATCC 27978), were found to degrade BTEX (benzene, toluene, ethylbenzene, and xylenes), common contaminants from gasoline storage-tank leakages. *T. aquaticus* and *Thermus* sp. were grown in a modified ATCC medium at 70°C and 61°C, respectively, and resting cell suspensions were used to study BTEX biodegradation at the same corresponding temperatures. The degradation of BTEX by these cell suspensions in sealed culture bottles was measured against controls that also displayed significant abiotic removals of BTEX under such high temperature conditions. For *T. aquaticus* at a suspension density of only 1.3×10^7 cells/mL and a total BTEX concentration of 58 ppm (0.62 mM), benzene, toluene, ethylbenzene, and an unresolved mixture of *o*- plus *m*- and *p*-xylenes were biodegraded by 10, 12, 18, and 20%, respectively, after 45 days of incubation at 70°C. For the *Thermus* sp. at a suspension density of 1.1×10^7 cells/mL and a total BTEX concentration of 87 ppm (0.93 mM), benzene, toluene, ethylbenzene, and the unresolved xylene mixture were biodegraded by 40, 35, 32, and 33%, respectively, after 45 days of incubation at 61°C. Raising the BTEX concentration lowered the extent of biodegradation. The biodegradations of both benzene and toluene were enhanced when *T. aquaticus* and *Thermus* sp. were pregrown on catechol and *o*-cresol, respectively, as carbon sources. Use of [U-¹⁴C]benzene and [U-¹⁴C]toluene verified that a small fraction of these two compounds were metabolized to water-soluble products and CO₂ by these non-growing cell suspensions within 7 days. This study represents the first time members of the

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naturally occurring, common thermophilic genus *Thermus* have been shown to have a co-metabolic potential for contaminant VOC degradation.